
Space Weather Technical Forecast

Issued on Tuesday 3 December 2024 at 00:56 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity was Low, with a peak flare of C4.9 observed at 02/1629UTC, probably from one of the largest regions in the southwest quadrant. There are currently eight sunspot regions on the visible disc, however these are generally simple with their magnetic configuration. The largest regions are AR3905 and AR3906 in the southwest disc. Both regions have remained largely inactive as they now approach the southwest limb, and have been showing signs of slight decay. AR3912 is also of note, as the largest of the regions in the southeast disc, however this is also relatively simple. The other regions remain relatively stable and inactive.

A couple of filament eruptions off the southwest quadrant, near the vicinity of AR3905 and AR3906 are currently being analysed for any potential Earth-directed components. No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds speeds, measured by ACE/DSCOVR at L1, were background to slightly elevated, ranging between 330km/s, rising to reach 490km/s, after the CME arrival from Nov 27. Density was mostly below average throughout. The Interplanetary Magnetic Field (IMF) strength, Bt, was moderate throughout, peaking at 14nT near the end of the period, due to the arrival of the CME. The north-south component (Bz) was mostly positive (northward) throughout, until the arrival of the CME, re-orientating to negative (southward), reaching -13nT deflection. The Phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background. The associated 24-hour fluence remained well below Active. The 03/0000 UTC observed was 1.12e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A slow CME from a filament eruption on 27 Nov arrived at Earth late on 02 Dec, however only limited enhancements are expected into day 1 (03 Dec). With no further enhancements from any CME arrivals or Coronal Holes, the solar wind speeds are

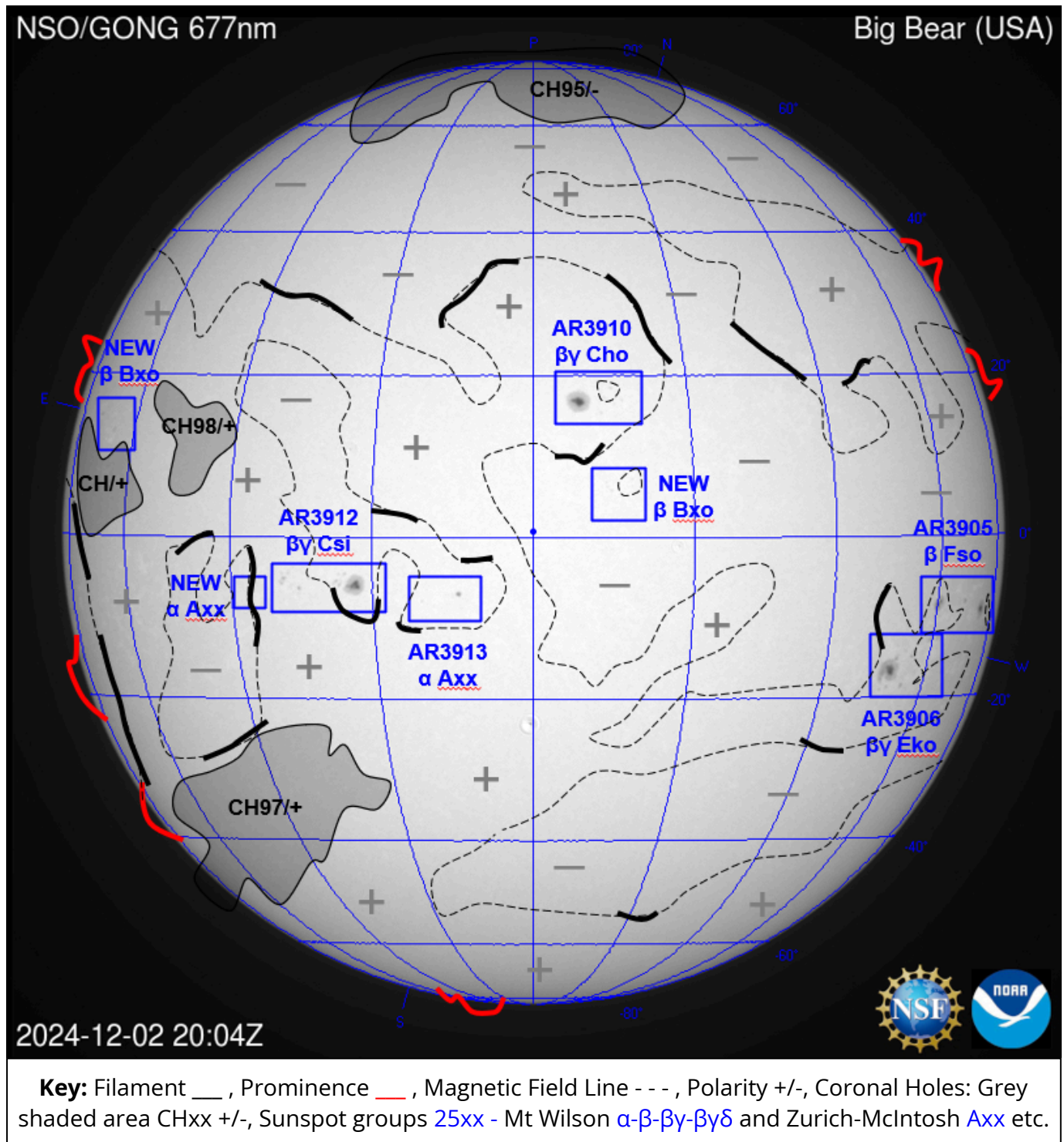
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

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expected to be slightly elevated to background throughout the period. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals throughout. Any CME enhancement on Day 1 (03 Dec) brings a slight chance of an Active spell.

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background with only a slight chance of responding as a result of any notable flare activity. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

Figure 1: Solar synoptic map - valid 02/2000 UTC.



Geomagnetic Storms

A CME associated with a filament eruption off the southeast disc, which left the Sun on 27 Nov, arrived at Earth 02/2000 UTC, although any enhancements in geomagnetic activity are expected to be limited, perhaps giving Unsettled to Active intervals early on day 1 (03 Dec).

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals from day 2 (04 Dec).

Solar winds are expected to be slightly elevated, between 400-450km/s, during day 1 (03 Dec), gradually declining to background levels from day 2 (04 Dec). Otherwise in the absence of any other CME enhancements, generally slow-ambient solar wind speeds are expected the remainder of the forecast period with no significant Coronal Hole enhancement expected. CH97+ too far south and CH98+ too far east.

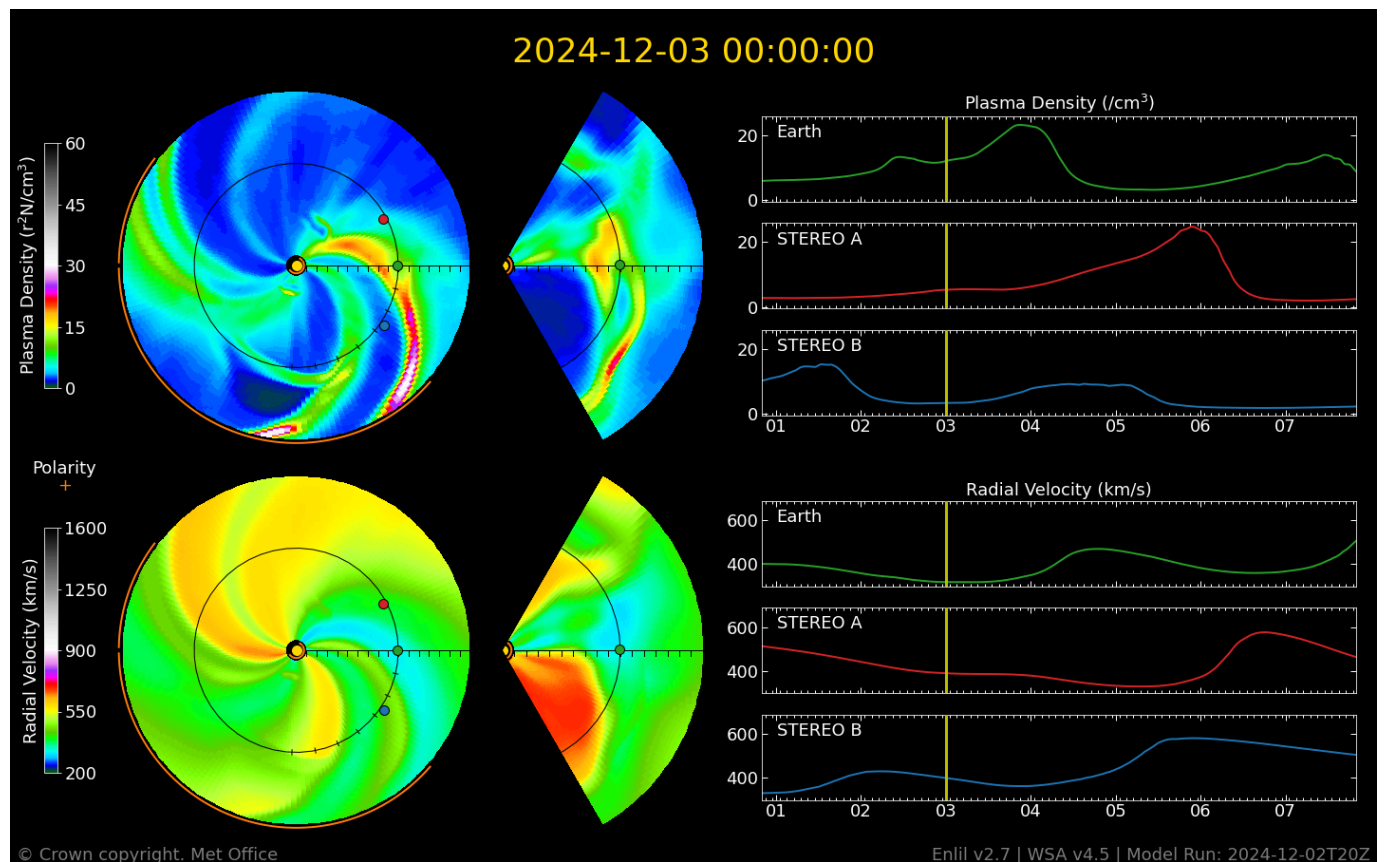
MOSWOC Enlil is currently providing reasonable support with slightly elevated winds at present, becoming slow through much of the forecast period. However, the enhancement to the solar wind speeds suggested into day 3 and 4 (03-04 Dec) are viewed with little confidence.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R _☉ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
28/11/2024 04:28	Partial	Filament	SE	390	02/12/2024 14:00 UTC	Moderate confidence of a glancing blow. Minimal enhancement expected.

Figure 2: MOSWOC Enlil



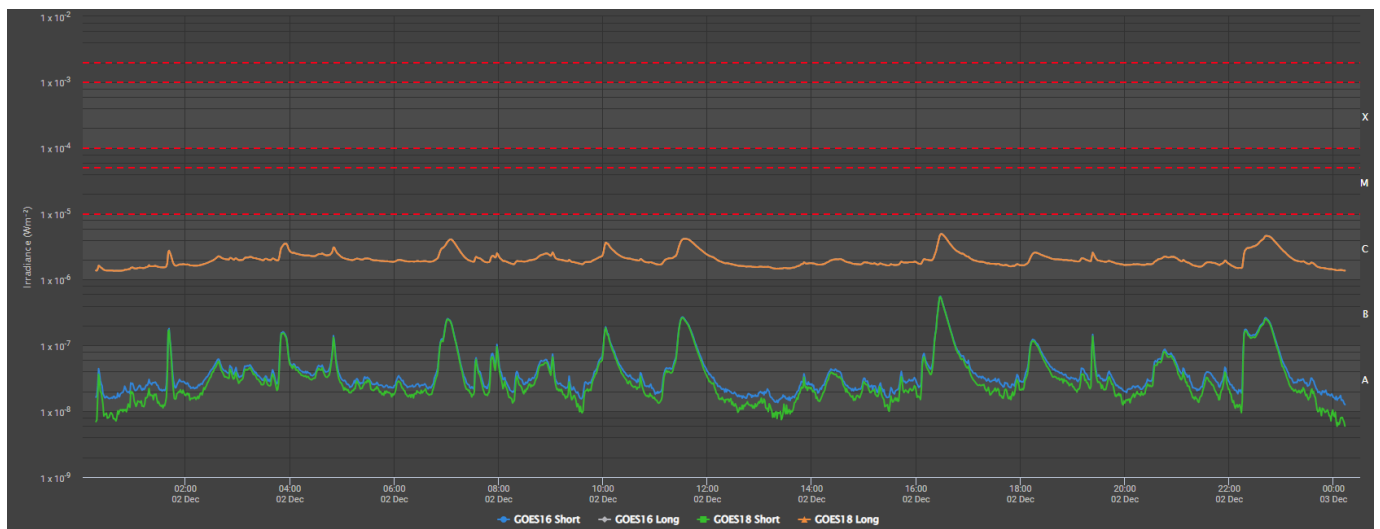
Radio Blackouts - X-Ray Flares

There are currently eight sunspot regions on the visible disc, however these are generally simple with their magnetic configurations. The largest regions are AR3905 and AR3906 in the southwest disc. Both regions have remained largely inactive as they now approach the southwest limb, and have been showing signs of slight decay. AR3912 is also of note, as the largest of the regions in the southeast disc, however this is also relatively simple. There are two newly numbered regions, one towards the centre disc in the southern hemisphere and another appearing around the eastern limb, this is currently classified as an Bxo region but given its location on the limb is currently difficult to analyse due to foreshortening. It will become clearer as it rotates further onto the disc. The other regions remain relatively stable and inactive. Magnetic looping evident in GOES SUVI 171 and some plage seen on GONG imagery suggests that another sunspot region may appear on the eastern limb within the next 12-24 hours.

Far-side data suggests a number of returning sunspots in the coming days, but this comes with some uncertainty until they rotate onto the visible disc. The other regions remain relatively stable and inactive. Overall Low to Moderate activity is expected with a slowly increasing chance of isolated M-class flares as likely oncoming regions add to the complexity on the disc.

Note, assessment of sunspot regions is currently more challenging than usual due to the prolonged outage of available SDO HMI/AIA data with a corresponding lower confidence in flare risk.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES16-18 X-Ray Flux trace.

Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and have remained largely inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a slight chance of high energy proton enhancement through this period.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	10	10	10	10
Very Active	$\geq \text{S3}^*$	No	1	1	1	1
* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and/or $50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times10^9$	No	1	1	1	1

Figure 4: MOSWOC electron fluence.